Mobile Positioning Technologies

By Steven Yap, 19 October 2000

About Positioning Technologies

Positioning Technologies is the technologies that provide location or position information, applications and services about users with the location finding system. It offers operators the opportunity to enhance revenues, reduce unwanted costs, provide new services and meet public safety requirements. For examples, the available location-based applications and services with positioning technology features for consumer include:

- Support for emergency 911 systems,
- Support for arresting and prosecution fraud perpetrators,
- Automatic vehicle location.
- Location sensitive billing or payments,
- Content filtering and behaviour change based upon the location, when they are travelling locally or overseas.

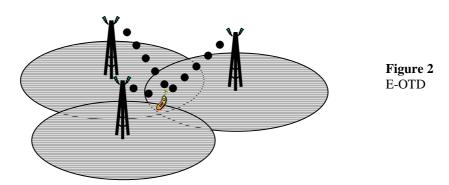
There are a number of technology alternatives for locating the position of mobile phones, including terminal-based and network-based solutions. The former build significant intelligence into the handset to achieve location whilst the later build more intelligence into the mobile network infrastructure.

Cell Of Origin (COO)

In this system, the mobile network base station (BTS) cell area is used as the location of the caller. Positioning accuracy generally depends upon the size of the cell but location down to 150 meters is possible in urban areas with the deployment of pico cell sites.

Enhanced-Observed Time Difference (E-OTD)

This system operate by placing location receivers (or reference beacons) overlaid on the cellular network as a LMU (Location Measurement Unit) at multiple sites widely dispersed as shown in Figure 2. Each of these receivers has an accurate timing source. When a signal from at least three base stations is received by an E-OTD software enabled handsets and the LMU, the time differences for the arrival of the signal from each BTS at the handset and the LMU are calculated. The differences in time stamps are then combined to produce intersecting hyperbolic lines from which the location is estimated.



Global Positioning System (GPS)

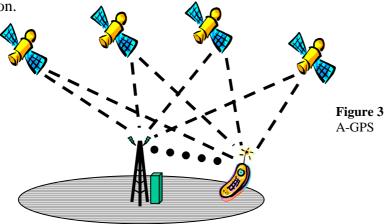
GPS utilizes a set of satellites (usually 3 to 4) to determine an X, Y position of a user position. The basis of GPS is "triangulation" from satellites, a GPS receiver measures

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distance using the travel time of radio signals along with the satellites' location. This raw information can either be processed by the terminal (device with built-in processing capabilities) or sent to the network for processing to generate the actual position.

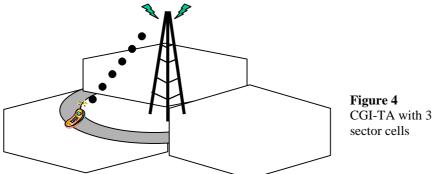
Network-Assisted GPS (A-GPS)

Network-assisted GPS enhances GPS availability. It uses fixed GPS receivers that are placed at regular intervals, every 200km to 400km to fetch data that can complement the readings of the terminal as shown in Figure 3. The assistance data makes it possible for the receiver to make timing measurements from the satellites without having to decode to calculate the location.



Cell Global Identity - Time Advance (CGI-TA)

CGI uses the identity of each cell with coverage area of a BTS to locate the user as shown in Figure 4. It works with existing terminals without modification. It is often complemented with the Time Advance (TA) information. TA is the measured time between the start of a radio frame and a data burst. This information is already built into the network and the accuracy is decent when the cells are small within a few hundred meters.



Time Of Arrival (TOA)

In a similar manner to E-OTD, the difference in TOA of a signal from a mobile device to three base stations is used to calculate the location. In this system, there may be no overlay network used as the LMU. Instead, the functionality is provided by synchronization of the cellular network, using GPS or atomic clocks at each base station.

Angle Of Arrival (AOA)

AOA uses the small aperture direction finding system which requires a complex 4 to 12 antenna array at each of several cell site locations. These antenna arrays can work together to determine the angle that relative to the cell site and from which a cellular signal is originated. By determine the respective AOA for several cell sites, cellular phone location can be

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estimated from the point of intersection (of projected lines drawn out from the cell site at the angle from which the signal originated).

Cell Broadcast (CB)

Cell Broadcast is designed for simultaneous delivery of messages to multiple users within a specified area. CB is one-to-many geographically focused service and messages are transmitted to multiple mobile phone customers located within a given part of its network coverage area at the time the message is broadcast. CB has some similarities with SMS since both services use the GSM network's signaling path.

Signal Attenuation (SA)

The location is estimated using existing signals operates on the principle of signal attenuation when the cellular phone travels towards or away from a base station. As mobile phone antennae are omni-directional, the power is dissipated rapidly in all directions. If the transmitted power of the mobile was known, and the power was measured at another point, the distance could be estimated using one of several propagation models.

Sources:

www.mobilepositioning.com

Useful related links:

Cambridge Positioning Systems

http://www.cursor-system.com

CellPoint

www.cellpt.com

SignalSoft

http://www.signalsoftcorp.com

SnapTrack

www.SnapTrack.com

Ericsson

www.ericsson.com

TruePosition

www.trueposition.com

US Wireless

www.uswcorp.com

Qualcomm/Lucent Technologies

www.qualcomm.com and www.lucent.com

BT Cellnet

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